Merced National Wildlife Refuge

Water Management Plan

2011-2015

December 2010

Record of Water Conservation Plan Adoption

By the wildlife refuge titled: **Merced National Wildlife Refuge**

This refuge has developed a **final water conservation plan (2011-2015) dated December 15, 2010**. The plan was developed to meet the Bureau of Reclamation criteria for evaluating water conservation plans of wildlife refuges. The Bureau of Reclamation has indicated that the final plan meets the criteria.

I have the authority to adopt the plan and begin implementation. This serves as a record that I have done so.

_____ Date: 27 April 11

Printed Name: Kim Forrest

Title: Complex Refuge Manager – San Luis National Wildlife Refuge Complex

Section A - Background

1. *Identify the staff member responsible for developing and implementing the Plan. Provide their contact information*

Name Kim Forrest Title Refuge Manager

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2. *Year refuge established* April 16, 1951

Define year-type used consistently throughout plan March 1 through February 28

3. *Water supplies* (Merced Unit and Arena Plains Unit)

List each annual entitlement of surface water under each water right and/or contract

Merced Unit

Supplier	*Water source*	*Contract #*	*Contract restrictions*	*Acre-feet/year*
Federal level 2	Merced ID/delivered	2179*	April 1-Oct. 31	16,000
Federal level 2	Merced ID/groundwtr	2179*	Undetermined	Augment to 16,000
State	NA			
Appropriative	Deadman Creek Duck Slough	19473 10139	Dec. 15-May 31 April 1– June 1	2,945 (9 cfs) 357 (3 cfs)
Other, riparian	Deadman Creek Mariposa Creek/Eastside Bypass	9575	Jan.1 – Dec. 31 Jan.1 – Dec. 31	Floodwater/ Tailwater Floodwater/ Tailwater

* *FERC Project/License Number*

Arena Plains Unit

Supplier	*Water source*	*Contract #*	*Contract restrictions*	*Acre-feet/year*
Federal	NA			
State	NA			
Appropriative	NA			
Other, riparian	Atwater Drain Eastside Canal		Jan.1 – Dec. 31 Jan.1 – Dec. 31	Floodwater/ Tailwater Floodwater/ Tailwater

Snobird Unit

Supplier	*Water source*	*Contract #*	*Contract restrictions*	*Acre-feet/year*
Federal	NA			
State	NA			
Appropriative	Brevel Slough/ Deep Slough	12268	*April 1-Oct. 31*	6,868 (31 cfs)
Other, riparian	N/A			

4. *Provide a narrative on pre-CVPIA refuge water supplies and water management*

   Ground wells provided most of the water supply used to manage the wetland and agricultural programs on the main unit of Merced NWR. Surface water from Deadman Creek was used to supplement management activities to a lesser extend when available due to an existing water right or floodwater/tailwater was available. Limited water supplies required the refuge to have minimal wetland acres and restrictive water management practices.

   CVPIA does not affect the Arena Plains Unit or Snobird Unit.

5. *Land use history* (Merced Unit, Arena Plains Unit, and Snobird Unit)

Merced Unit

Identify habitat types specific to this refuge. Attach a refuge map showing habitat location and size

List refuge habitat-types with 5% or more of total acreage

Habitat type	*Original size*	*1992 acres*	*1997 acres*	*2010 acres*
Seasonal wetland – timothy (not irrig)				
Seasonal wetland – timothy (irrigated)	1000	725	985	1,136
Seasonal wetland - watergrass			304	304
Permanent wetland		21	41	41
Semi-permanent wetland/brood pond			88	88
Riparian			48	48
Irrigated pasture		354	391	391
Upland				
Upland (not irrigated)	848	2,421	2,189	3,278
Upland (irrigated)		75	40	40
Upland (crop lands)	707	446	453	453
Other (>5%)				
Misc. habitat (<5%)				
Sub-total – habitat acres	2,555	4,042	4,537	5,779
Roads, buildings, etc.	7	113	114	114
Total (size of refuge)	2,562	4,155	4,651	5,893

Describe refuge habitat-type water use characteristics

Habitat type	*AF/ac*	*# of irrigations*	*Flood date*	*Draw down date*
Seasonal wetland	8.00	0	Aug-Nov	Feb-May
Seasonal wetland - timothy	8.00	1-2	Aug-Nov	Feb-May

Seasonal wetland - watergrass	8.00	2	Aug-Nov	Feb-May
Permanent wetland	10.00	NA	All year	NA
Semi-permanent wetland/brood pond	8.75	NA	Oct-Jan	Aug
Riparian				
Irrigated pasture	2	14	Apr-Oct	NA
Upland (not irrigated)				
Upland (managed)	0	0	NA	NA
Upland (grains)	2	14	Apr-Oct	NA
Other (>5%)				
Misc. habitat (<5%)				

Arena Plains Unit

Identify habitat types specific to this refuge. Attach a refuge map showing habitat location and size

List refuge habitat-types with 5% or more of total acreage

Habitat type	*Original size*	*1997 acres*	*2010 acres*
Seasonal wetland – timothy (not irrig)	331	222	222
Seasonal wetland – timothy (irrigated)			
Seasonal wetland - watergrass			
Seasonal wetland – vernal pool	13	13	13
Permanent wetland			
Semi-permanent wetland/brood pond		275	275
Riparian	20	5	5
Irrigated pasture			
Upland			
Upland (not irrigated)	1,986	1,835	1,835
Upland (managed)			
Upland (grains)			
Other (>5%)			
Misc. habitat (<5%)			
Sub-total – habitat acres	2,350	2,350	2,350
Roads, buildings, etc.	114	114	114
Total (size of refuge)	2,464	2,464	2,464

Describe refuge habitat-type water use characteristics

Habitat type	*AF/ac*	*# of irrigations*	*Flood date*	*Draw down date*
Seasonal wetland	8.00	0	Aug-Nov	NA
Seasonal wetland - timothy	8.00	0	Aug-Nov	NA
Seasonal wetland – vernal pool		0	Dec-May	NA
Permanent wetland	10.00	NA	All year	NA
Semi-permanent wetland/brood pond	8.75	NA	Oct-Jan	NA
Riparian				NA

Irrigated pasture		0	Apr-Oct	
Upland (not irrigated)				NA
Upland (managed)		0	NA	
Upland (grains)		0	Apr-Oct	NA
Other (>5%)		0		NA
Misc. habitat (<5%)				

Snobird Unit

Identify habitat types specific to this refuge. Attach a refuge map showing habitat location and size

List refuge habitat-types with 5% or more of total acreage

Habitat type	*Original size*	*1997 acres*	*2010 acres*
Seasonal wetland – timothy (not irrig)	779	779	154
Seasonal wetland – timothy (irrigated)	21	21	
Seasonal wetland - watergrass			
Seasonal wetland – vernal pool	19	19	19
Permanent wetland			
Semi-permanent wetland/brood pond			2.6
Riparian	19	19	19
Irrigated pasture	544	544	0
Upland			
Upland (not irrigated)	498	498	1685
Upland (managed)			
Upland (grains)			
Other (>5%)			
Misc. habitat (<5%)			
Sub-total – habitat acres	1,880	1,880	1,880
Roads, buildings, etc.	25	25	25
Total (size of refuge)	1,905	1,905	1,905

Describe refuge habitat-type water use characteristics

Habitat type	*AF/ac*	*# of irrigations*	*Flood date*	*Draw down date*
Seasonal wetland	8.00	0	Aug-Nov	NA
Seasonal wetland - timothy	8.00	0	Aug-Nov	NA
Seasonal wetland – vernal pool		0	Dec-May	NA
Permanent wetland	10.00	NA	All year	NA
Semi-permanent wetland/brood pond	8.75	NA	Oct-Jan	NA
Riparian				
Irrigated pasture		0	Apr-Oct	NA
Upland (not irrigated)				
Upland (managed)		0	NA	NA
Upland (grains)		0	NA	NA

Other (>5%)		0		
Misc. habitat (<5%)				

Section B - Water Management Related Goals and Objectives

1. *Describe the refuge mission relative to water management. (i.e. crop depredation, legislative mandates, service to landowners)*

The majority of purposes for Merced NWR involve habitat for wetland dependent wildlife species. In this artificially created and maintained system, efficient water management is critical to accomplishing these purposes.

Purposes for the management units of Merced NWR:

On April 16, 1951, The Department of the Interior, under the authority if the Lea Act (16 U.S.C. 695-695c), approved the purchase of lands to create the Merced National Wildlife Refuge:

"...for the management and control of migratory birds and other wildlife..."

All other Refuge units acquired since its original founding has been acquired under the Migratory Bird Conservation Act (16 U.S.C. 715d):

"...for use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

2. *Describe specific habitat management objectives. Include pertinent information from refuge management plans*

The management goals and objectives of the San Luis NWR Complex include:

- Manage and provide habitat for endangered, threatened, and sensitive wildlife and plant species.
- Produce optimum habitat conditions for wintering waterfowl, waterbirds, and other migratory birds.
- Maintain and enhance the biodiversity associated with the Central Valley's plant communities.
- Provide an area for compatible recreational programs; which include environmental education, interpretation, wildlife observation, photography, hunting, and fishing; and management-oriented research and education/interpretation.

Seasonal Wetlands

Seasonal wetlands are inundated fields or ponds that are managed primarily to grow seed and to produce invertebrates for migratory waterfowl, shorebirds, and other wetland dependent wildlife. These wetlands are usually shallow, flooded October through March, and dry for the rest of the year except for summer irrigations. Some seasonal wetlands are inundated by early August, depending on the habitat required for early arriving waterfowl. Some seasonal wetlands may be kept inundated through April to provide habitat for migrants that do not depart to northern breeding habitats until that time.

Seasonal wetlands provide much of the life requirements for the primary migratory bird species for which the wildlife areas were acquired. These wetlands consist of two subtypes—leveled and unleveled.

Leveled seasonal wetlands are normally created by restoring wetlands from previously developed croplands. These lands were originally leveled by farmers using rough estimation in earlier years or laser levels more recently. Restoration may entail re-contouring a portion of the field to facilitate water flow, but most of the original contours are retained. All or part of the original levees and internal delivery ditches are usually incorporated into the unit design. This habitat subtype is easily managed to produce large quantities of waterfowl and shorebird food. Leveled seasonal wetlands have a fairly uniform water depth when inundated to the optimum elevation, not varying more than 1.5 feet and often varying less than 0.5 foot, within large ponds (40 acres or more). They are generally inundated levee to levee with little land surface above the water

other than loafing islands and the levees themselves. The construction of meandering levees and/or islands within these seasonal wetlands enhances the diversity of migratory bird usage.
Primary food production plant species found within this habitat type are watergrass (or wild millet), smartweed, swamp timothy, and alkali bulrush. Other plant species found in the leveled wetlands are cattails, hardstem bulrush, Baltic rush, cocklebur, jointgrass, spike rush, and other hydrophytes.

These shallow seasonal marsh areas provide feeding, loafing, and roosting habitat for a wide variety of waterfowl. They also provide all necessary habitat requirements for many species of shorebirds. Herons, egrets, white-faced ibis, and California gulls forage in seasonal wetlands and sandhill cranes loaf and roost in them. During the dry summer periods, many raptors, including northern harriers and Swainson's hawks, as well as mammalian predators forage for small mammals and other vertebrates in this habitat.

The unleveled subtype of seasonal wetlands (**natural basins, seasonally flooded channels, and vernal pools**) has greater variation in water depth and often deeper waters. The irregular topography and shorelines often combine to form a mosaic of open water, islands, stands of cattail/bulrush, shoreline points, and shallow flooded flats. Because of the varied water depth and reduced manageable acres in this subtype, seed production from moist soil food plants is greatly reduced. However, that same variation provides a greater diversity of aquatic plant species and different foraging substrates for a large array of waterfowl and shorebird species. The vernal pools produce dense populations of invertebrates that are heavily used by waterfowl and shorebirds during the pre-migration and nesting period. In addition, the islands and irregular shorelines of this habitat subtype generally provide a higher ratio of loafing sites to open water than any of the other habitat types described here.

Portions of the unleveled seasonal wetlands also provide excellent roosting and foraging habitat for geese and sandhill cranes. The shallow vegetated shorelines provide good habitat for many species of wading birds. Wetland plants within the subtype are similar to those in the leveled habitat. The adjacent upland portions are dominated by annual and perennial grasses (soft chess, beardless wild rye, saltgrass, and alkali sacaton), interspersed with native and introduced forbs.

The water requirements and scenario of water applications within seasonal wetlands varies, depending on the habitat subtype and type of plant foods desired. Vernal pools and some of the seasonally flooded channels will not receive any applied waters. The two most common scenarios for seasonal wetlands are for production of swamp timothy and watergrass, each having its own unique water requirements.

Swamp timothy. Production and management in an average water year would typically have the following water management pattern. Drawdown (draining of winter floodwater and drying of the soils) would occur in the last two weeks of March through the first two weeks of April. The soils dry and warm to allow germination of seeds and initial vegetative growth. A first irrigation, requiring approximately 0.75 foot of water, is applied sometime in the first two weeks of April through the first two weeks in May, depending on annual weather patterns and soil composition. A second irrigation to ensure heavy seed production and vegetative structure is applied during the last two weeks of May through the first two weeks of June. Swamp timothy is then left dry to let the plants mature and the seeds cure before fall. Fall flooding is initiated in September or October, depending on when wetlands are required for the migrating waterfowl. The initial inundation requires 2.0 feet of water. Over the two-month period of September and October, it takes 3.0 feet of water to cover the whole acreage. Part of the land is flooded in September and additional land is flooded in October. Approximately 0.5 foot of water must be applied to the seasonal wetland each month, November to March, — to maintain optimum water depth. This management scenario requires an annual average of 8.0 feet of water.

Mixed marsh (watergrass). Seasonal wetlands managed for watergrass (as the primary food plant) or other hydrophytes (such as smartweed) has the following pattern of water management and requirements in a normal year. Pond drawdown for watergrass germination can occur from early April through early May. The first irrigation is applied in late May or early June. This irrigation requires approximately 1.0 foot of water. Second and third irrigations require about the same amount of water as the first and are applied in late June and July. Again the crop is allowed to dry, promoting maturing and seed curing before fall flooding.

The next flooding of watergrass occurs between August and October. The August flooding (0.25 foot) of some seasonal wetland habitat is essential for early fall migrant waterfowl that start arriving in mid-August. A September flooding requires about 0.75 foot. Recent aerial surveys (1987-1991) have shown 80,000 to 95,000 waterfowl in the Grasslands by September 15. Thousands of migratory shorebirds may also be present during this period. The first flooding (about October) requires approximately 2 feet. An additional 0.5-foot every month after flood-up until March is required to maintain optimum foraging conditions. This scenario requires an annual average of 8.0 feet of water. Watergrass is sometimes cultured similar to rice with the ponds kept wet or flooded from the time the plants emerge until early spring. The water level is kept under the growing vegetation. This method produces much more vegetation and requires up to 50 percent more water to maintain. This also produces an abundance of invertebrates and crustaceans, thus providing both a food base and cover for a variety of resident bird species.

Semi-permanent Wetlands

Semi-permanent wetlands are kept flooded approximately 8 months or more of the year and are managed to provide wetlands when the expanses of seasonal wetlands are not flooded (summer). Water is maintained at greater depths in semi-permanent wetlands than in seasonal wetlands and this type is dominated by different organisms. The dominant plant species are cattails and hardstem bulrush with submerged vegetation, including sago pondweed and horned pondweed, in the open water area. Duckweed grows on the surface of these wetlands. Scattered black willows are established on the perimeter of these ponds. Most of the plant organisms found in seasonal wetlands are also found in small quantities in the shallow edges of semi-permanent wetland.

Semi-permanent wetlands provide production habitat for many species of resident waterbirds and foraging habitat for other wetland dependent wildlife. This habitat provides nesting, foraging, and roosting habitats for black-crowned night herons and marsh wrens; foraging and roosting habitat for egrets; nesting and roosting habitat for tri-colored blackbirds and white- faced ibis; brooding habitat for ducks; foraging habitat for raccoons and giant garter snakes; and summer marsh habitat for a host of other wetland dependent wildlife.

Water requirements for semi-permanent wetlands are significantly greater than that required for seasonal wetlands of a comparable size because they are flooded for a longer period each year and are maintained through the hottest, driest times of the year.

Ponds managed as semi-permanent wetlands in some years may be managed as seasonal wetlands in others and vice versa as a management technique to manipulate vegetation types and densities. This allows for greater diversity within the management unit as a whole.

Water required to manage semi-permanent wetlands will vary with the length and timing of inundation. Some ponds will be allowed to go dry as early as August as other seasonal wetlands are flooded, while other semi-permanent wetlands will require water February through November. Water requirements in a typical semi-permanent wetland in a normal water year will be approximately 0.5 foot during February and November, 0.75 foot during March, April, and October; 1.0 foot May through July; and 1.25 feet in August

and September, for an average annual total of 8.75 feet. These amounts vary slightly from wetland to wetland, so but the total annual average is approximately 3.5 feet.

Permanent Wetlands

Permanent wetland habitat includes two subtypes. One type (freshwater marsh) is wetland areas that are inundated year round, are not flowing, contain emergent vegetation, but do not support woody vegetation. A second type is freshwater lakes. Water depths in permanent wetlands are deeper than in seasonal wetlands but are still relatively shallow. Even in the freshwater lakes, water rarely exceeds 8 feet deep. When properly situated, permanent wetlands can act as reservoirs for supply to other habitats and can also be maintained through runoff from other habitats.

Vegetation in permanent wetlands is dominated by cattails and hardstem bulrush. Black willows grow in scattered groups on the edges of freshwater lakes. The margins of permanent wetlands support plants typical of seasonal wetlands. Submerged vegetation in the permanent wetlands is common and includes sago pondweed, wigeongrass, water milfoil, and horned pondweed.

Permanent wetlands provide habitat for numerous fish species such as striped bass, sunfish, catfish, and largemouth bass. Bullfrogs, western pond turtles, and giant garter snakes inhabit the edges of this habitat. White pelicans, double-crested cormorants, California gulls, and several species of diving ducks use these areas as resting and feeding places. Other benefits of permanent wetlands are very similar to those of semi-permanent wetlands.

Water requirements for permanent wetlands are similar to those of semi-permanent wetlands once they are filled. A typical permanent wetland in a normal water year will require approximately 0.5 foot, February and November; 0.75 foot, March and October; 1.0 foot, April through June; and 1.5 feet, July through September, for an annual total of 10 feet.

Croplands

Croplands are fields that are managed to produce food and cover crops that do not occur naturally and require more intensive farming to maintain than the food and cover produced in the wetland habitats. Croplands as managed on wildlife areas normally have three distinct subtypes, each having different water requirements and production objectives. The three subtypes are irrigated pasture, corn production, and small grain production.

One scenario of managing irrigated pasture is indicated here. Other management regimes are used at different times or by different agencies. The irrigated pasture may be managed to create tall (2- to 3-foot) dense nesting habitat during the spring months for ducks, pheasant, northern harriers, short-eared owls, other ground nesting birds, and mammals. The same pastures may be managed to produce short green grazing and loafing habitat for sandhill cranes and geese in the winter. The dual use will be accomplished through a closely controlled haying and/or livestock grazing program after each nesting season.

Vegetation within the irrigated pasture may consist of Dallas grass, perennial fescues, ryegrass, clover, vetch, and trefoil. This vegetation will require periodic irrigations through the long summer to remain vigorous. Typical annual water requirements for irrigated pasture are 0.5 foot, April and May; and 0.75 foot, March, June, July, and September. The average annual water requirement is 4.0 feet. Other management regimes within the irrigated pasture subtype may differ from the details presented here.

Corn production is labor intensive and requires considerable water. However, corn produces large quantities of high energy food (carbohydrates) used by seed eating wildlife. The primary reason the crop is grown is to feed sandhill cranes and geese during the winter. Additionally, blackbirds, mourning doves, pheasants, finches, ducks, meadow voles, deer mice, cottontails, ground squirrels, and many other species use the corn grain throughout the year. These species in turn are preyed upon by both avian and mammalian predators. Typical water requirements for corn are 1.5 feet in May (pre-irrigation and planting) and 1.0 foot each month in June through August. The average annual water requirement for corn is 4.5 feet.

Small grain production croplands are used to produce food and cover. The primary crops grown are barley, wheat, safflower, and vetch. All of these crops are planted in the fall or winter and produce good crops of high energy (carbohydrates) food using little water. These crops provide nesting and escape cover in the spring and summer. The same species that use the corn crop use these crops and obtain the same benefits, but the sandhill cranes prefer mowed corn. Also, the vetch and safflower are not heavily used by waterfowl as a source of food unless flooded. The advantage of small grains is that they provide fall green feed and diversity and can be produced with a minimum of water during a typical mild winter. These crops are rotated within the fields so the soils do not become depleted of nutrients by producing the same plants year after year. Water required for all of these plant species is 1.0 foot in late October or early November as a pre-irrigation to germinate the seed and start growth. The plants then grow using naturally occurring winter moisture until spring (March) when another 0.75-foot irrigation is applied to ensure heavy seed production. The average annual water requirement for small grain production is 1.75 feet.

The Service uses cooperative farming agreements to produce wildlife food on the cropland areas. Organic farming principles (crop rotation, green manure plowdown, natural fertilizers, integrated pest management, etc.) are mandated. Pastures and alfalfa crops are periodically hayed by the permittee, with a 4-6 inch growth left for the wintering flocks of sandhill cranes and geese. The small grains and corn are normally mowed or lightly disced for maximum use by the geese, cranes, and several species of ducks.

Riparian Habitat

Riparian habitat is permanent and semi-permanent wetland habitat along both natural or man-made water channels and their backwaters. Riparian habitat is found in association with the San Joaquin River, Bear Creek, Salt Slough, Mud Slough North, and Mud Slough South. Riparian habitat is managed to enhance the dense mixture of trees, shrubs, and streamside vegetation that naturally occurs. Native tree species indigenous to the vicinity are occasionally planted to accelerate the restoration of riparian habitats. Dominant plant species in the riparian corridors are black and sandbar willow, cottonwood, valley oak, buttonbush, atriplex, and wildrose. Subdominant riparian corridor vegetation includes burreed, cattail, hardstem bulrush, rabbitsfoot grass, creeping wildrye, and many other species. The riparian corridors provide suitable habitat for a variety of resident and migratory passerine birds as well as various hawks, owls, egrets, and herons. The riparian habitat also supports raccoon, beaver, mink, muskrat, western pond turtles, and giant garter snakes.

Water to maintain riparian habitat is critical but is not managed. The habitat is dependent on the flows in the streams that support it, and no water is directly allocated or provided to the habitat except that which first passes through or is used in one of the other habitat types. However, because riparian habitat is very limited but crucial to many sensitive wildlife species in the San Joaquin Valley, it is essential to provide sufficient water to maintain it.

Natural Grass Uplands

Natural grass uplands are portions of wildlife areas that mostly have natural topography and support self-sustaining vegetation. They are managed to maintain the native vegetation and wildlife species they support. Common plant species found within the natural grass uplands are soft chess, filaree, tarweed, creeping wildrye, alkali sacaton, saltgrass, red brome, fescue, and meadow barley. This habitat supports deer mice, meadow voles, kangaroo rats, ground squirrels, long-tailed weasels, cottontail, coyotes, San Joaquin kit fox, horned larks, meadowlarks, and many other wildlife species.

No imported water is used in the natural grass upland except for that applied to seasonal wetlands that meander through them. This habitat is managed by controlled burns and closely controlled livestock grazing.

Fire and grazing are used to reduce non-native annual grass growth, increase native perennial grass vigor and seed production, enhance native forbs, and improve grazing and loafing conditions for sandhill cranes and geese. Other upland-dependent bird species, such as the long-billed curlew, mountain plover, and horned larks also benefit from burning and grazing.

3. Describe the strategies used to attain objectives listed above
On an annual basis conduct a review of the previous habitat management plan, which involves visiting each habitat unit to document accomplishments, establish needs and develop plans for the upcoming year and compile these findings to produce the next habitat management plan. (See Appendix I for water flood up and draw down schedules).

4. Describe constraints that prevent attainment of objectives and explain the effect on operations
The habitat planning process identifies a far greater workload than can be accomplished in a single year, given present funding, staffing and existing priorities. Typically, CVPIA budget cycles do not allocate water acquisition funding until six months into the fiscal year, preventing refuge managers from planning an entire year of habitat management and results in inefficient water use.

5. Describe the strategies used to remedy the constraints listed above
Continue to refine management techniques, to improve efficiency, and develop alternate/additional funding sources to help address present staffing and water limitations.

Section C - Policies and Procedures

1. Describe the Refuge policies/procedures on accepting agricultural drainage water as supply.
Upslope drainage water is accepted by Merced Refuge (as well as the Arena Plains unit) because MID canal deliveries (and other agricultural drains) include recirculated water that has been previously used on agricultural fields.

2. Describe the Refuge policies/procedures on water pooling, transfers, reallocations or exchange.
The refuge and US FWS has no policies or procedures on pooling, transfers, reallocations or exchange but follows those established by the CVPIA and in the water supply contracts.

3. Describe the Refuge water accounting policies/procedures for inflow, internal flow and outflow.
Irrigators collect data (water levels) by month for individual wetland units and water deliveries and groundwater use is checked monthly by managers. Outflow is currently estimated.

4. Describe the Refuge water shortage policies/procedures.

Based on established refuge purposes (see B1) and the projected water supply, we will determine monthly critical habitat needs, analyze existing water use records by both refuge unit and habitat type, to determine the amount, distribution and timing of each habitat to be flooded.

Section D - Inventory of Existing Facilities

1. *Mapping*

   Attach existing facilities map(s) that show points of delivery, turnouts (internal flow), and outflow (spill) points, measurement locations, conveyance system, storage facilities, operational loss recovery system, wells, and water quality monitoring locations. Describe in the body of the plan the information contained in each attached map

The attached map (Attachment B) shows points of delivery, turnouts (internal flow), and outflow (spill) points, measurement locations, operational loss recovery points and the conveyance system.

2. *Water measurement*
   a. *Inflow/deliveries*

Merced Unit

Total # of inflow locations/points of delivery 2

Total # of measured points of delivery 2

Percentage of total inflow (volume) measured during report year 100%

Delivering agency	*Conveyance facility*	*Measuring point*	*Refuge distribution facility*	*% of total inflow*	*Type of measurement*	*Measuring agency*
Merced ID	Lake McClure	Deadman Creek	Lift Pump Station	99%	Weir	Merced ID
Merced ID	Mariposa Creek Lake McClure	Duck Slough	Water Control Structure	1%	Weir	N/A

Arena Plains Unit

Total # of inflow locations/points of delivery 2

Total # of measured points of delivery 0

Percentage of total inflow (volume) measured during report year 0%

Delivering agency	*Conveyance facility*	*Measuring point*	*Refuge distribution facility*	*% of total inflow*	*Type of measurement*	*Measuring agency*
Turlock ID	Lake McClure	Atwater Drain	Water Control Structure	99%	None	NA
Stevenson Water Co.	Lake McClure	Eastside Canal	Water Control Structure	1%	None	N/A

Snobird Unit

Total # of inflow locations/points of delivery 1

Total # of measured points of delivery 0

Percentage of total inflow (volume) measured during report year 0%

Delivering agency	*Conveyance facility*	*Measuring point*	*Refuge distribution facility*	*% of total inflow*	*Type of measurement*	*Measuring agency*
Stevenson Water Co.	Lake McClure	Eastside Canal	Water Control Structure	1%	None	N/A

b. Internal flow at turnouts

Merced Unit

Total # of refuge water management units (units) 74

Total # of refuge water management unit turnouts 787

Total # of measured turnouts 0

Estimated percentage of total internal flow (volume) during report year that was measured at a turnout 0

Measurement type	*Number of devices*	*Acres served*	*Accuracy (avg or range)*	*Reading frequency*	*Calibration frequency (months)*	*Maintenance frequency (months/days)*
Orifices						
Propeller						
Weirs	8	912	NA	Monitored, not read	Never	Monthly
Flumes						
Venturi						
Alfalfa valves	779	971	NA	Monitored, not read	Never	Monthly
Metered gates						
Other, stop-log and screwgates			NA	Monitored, not read	Never	Monthly

Arena Plains Unit

Total # of refuge water management units (units) 6

Total # of refuge water management unit turnouts 12

Total # of measured turnouts 0

Estimated percentage of total internal flow (volume) during report year that was measured at a turnout 0

Measurement type	*Number of devices*	*Acres served*	*Accuracy (avg or range)*	*Reading frequency*	*Calibration frequency (months)*	*Maintenance frequency (months/days)*

Orifices	3	117	NA	Monitored, not read	Never	Quarterly
Propeller						
Weirs	9	375	NA	Monitored, not read	Never	Quarterly
Flumes						
Venturi						
Alfalfa valves						
Metered gates						
Other, stop-log and screwgates						

Snobird Unit

Total # of refuge water management units (units) 5

Total # of refuge water management unit turnouts 2

Total # of measured turnouts 0

Estimated percentage of total internal flow (volume) during report year that was measured at a turnout 0

Measurement type	*Number of devices*	*Acres served*	*Accuracy (avg or range)*	*Reading frequency*	*Calibration frequency (months)*	*Maintenance frequency (months/days)*
Orifices						
Propeller						
Weirs	3	104	NA	NA	Never	Planned installation
Flumes						
Venturi						
Alfalfa valves	2	50	NA	NA	Never	Planned installation
Metered gates						
Other, stop-log and screwgates						

c. *Outflow*

Merced Unit

Outflow (AF/yr) 2,539

Total # of outflow locations/points of spill 25 (2,651 acres)

Total # of measured outflow points 0

Percentage of total outflow (volume) measured during report year 0

Outflow point	*Measuring point*	*Type of measurement*	*Percent of total outflow*	*Measuring agency*	*Acres drained*

			(estimated)		
North Merced	Outlet structure	Flow meter and weir	7	USFWS	104
Mariposa A	Outlet structure	Flow meter and weir	13	USFWS	199
LP7	Outlet structure	Flow meter and weir	14	USFWS	220
LP8	Outlet structure	Flow meter and weir	27	USFWS	422
Octagon	Outlet structure	Flow meter and weir	5	USFWS	72

Arena Plains Unit

Outflow (AF/yr) 824

Total # of outflow locations/points of spill 3

Total # of measured outflow points 0

Percentage of total outflow (volume) measured during report year 0

Outflow point	*Measuring point*	*Type of measurement*	*Percent of total outflow (est.)*	*Measuring agency*	*Acres drained*
Eastside Canal	None	None	70	FWS	2,464

Snobird Unit

Outflow (AF/yr) 154

Total # of outflow locations/points of spill 2

Total # of measured outflow points 0

Percentage of total outflow (volume) measured during report year 0

Outflow point	*Measuring point*	*Type of measurement*	*Percent of total outflow (est.)*	*Measuring agency*	*Acres drained*
Bear Creek	None	None	60%	FWS	104
Upland	None	None	40%	FWS	50

3. Identify the type and length of the refuge internal distribution system

Merced

Miles unlined canal	*Miles lined canal*	*Miles piped*	*Miles – other*
4.7	0	14.3	0

Arena Plains

Miles unlined canal	*Miles lined canal*	*Miles piped*	*Miles – other*
0	0	0	.25

Snobird

Miles unlined canal	*Miles lined canal*	*Miles piped*	*Miles – other*
0.5	0	0	0

Describe the location and types of identified leaks and areas of higher than average canal seepage, and any relation to soil type.

Refuge staff has not identified any significant leaks or areas of higher than average canal seepage. No areas of high seepage due to soil type (gravel lens, etc.) have been identified.

4. *Describe the refuge operational loss recovery system*

Merced

Pump #	Location	HP
LP8E	West of Teal Marsh B	30
LP9	West of LP8E	25

Arena Plains

Pump #	Location	HP
NA	NA	NA

Snobird

Pump #	Location	HP
NA	NA	NA

5. *Groundwater (Bulletin 118, DWR website)*

Describe groundwater availability, quality and potential for use

Groundwater Plan *No* ___X___ *Yes* _____.

Groundwater basin(s) that underlie the refuge

Name of basin underlying refuge	*Size (sq. mi.)*	*Usable capacity (AF)*	*Safe yield (AF/Y)*	*Management agency*	*Relevant reports*
San Joaquin Basin	13,500	80,000,000	Unknown	NONE	USBR

Merced Unit

Identify refuge-operated deep wells

#	*Location*	*Status*	*HP*	*2009 (AFY)*	*Future plans*
R1	Deadman 5	Active	30	505.52	
R2	Red Barn	Active	30	356.25	
R3	Deadman Weir	Active	25	390.38	
R6	East Dowitcher	Active	30	663.56	
R7	Section 35	Active	50	256.51	
P1	East Marsh B	Active	50	683.91	Increase efficiency
P2	E of Entrance	Active	60	375.49	

P4	N of Lift Pumps	Active	40	454.69	
P5	Headquarters	Active	60	155.19	
P6	West Farm 3	Active	50	0	
P9	West Farm 1	Active	30	438.81	Increase efficiency
P10	West Farm 2	Active	50	582.85	Increase efficiency
P12	East Farm 2E	Active	40	664.46	Increase efficiency
P13	East Farm 5	Active	30	380.99	Increase efficiency
P14	Meadowlark	Active	40	0	
P15	East Farm 2W	Active	40	487.26	Increase efficiency
P17	Mariposa C	Active	75	208.83	Increase efficiency
P18	Mariposa A	Active	60	375.05	Increase efficiency
P19	East Farm 4	Active	50	578.83	Increase efficiency
P20	East Farm 3	Active	50	471.51	Increase efficiency
P21	Crane Field A	Active	40	782.37	Cap
P23	East Marsh F	Abandoned		NA	Cap

Arena Plains Unit

Identify refuge-operated deep wells

#	*Location*	*Status*	*HP*	*2009 (AFY)*	*Future plans*
AP 1	N of Crane Lake	Active	75	471.05	
AP 2	Btwn Cackler and Pelican Lakes	Active	125	193.66	

Snobird Unit

Identify refuge-operated deep wells

#	*Location*	*Status*	*HP*	*2009 (AFY)*	*Future plans*
SB 1	N. Snobird	Active	30	0	Activate 2011
SB 2	Pole Barn	Inactive	50	0	Activate 2013
SB 3	Middle Snobird Marshes	Active	50	0	Activate 2011
SB 4	S. Middle Snobird	Inactive	30	0	Activate 2013
SB 5	South Snobird	Inactive	50	0	Activate 2013

Section E Environmental Characteristics

1. *Topography - describe and discuss impact on water management*

Relatively flat with slope from NW to SE. The water impact of this gentle NW to SE slope is that the refuge takes a maximum amount of delivered water on along the north and west boundaries to that the supply can be used in multiple units as it gravity flows towards the SE spill points.

2. *Soils - describe and discuss impact on water management (see map below)*

Soils in the area's westside can generally be characterized as poorly drained and alkaline. The soils in the valley basin, along the floodplain of the San Joaquin River, formed in mixed alluvium that is predominantly granite transported from the Sierra Nevada. Soils on the alluvial fans and the valley basin rim west of the

river formed in mixed alluvium derived predominantly from sedimentary rock form the Coast Range Mountains. The water table is near the surface throughout the area.

Soil texture ranges from dense clay to sandy loam in the project area, with evidence of a total of 14 soil series. Local soils are calcareous and often salt affected. Trace element concentrations generally are within the range typical for western soils – generally low to moderately elevated.

3. *Climate*

CIMIS-Station 56 - Los Banos, CA. (Jun 1988 - Nov 2010)

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*
avg precip	1.66	2.07	1.51	0.61	0.42	0.06	0.04	0.03	0.14	0.49	0.69	1.26	8.9
avg. temp	55.5	61.3	67.4	72.3	80.1	87.1	92.4	91.7	88.1	78.1	65	55	74.5
max temp	59.2	65.5	73.8	77.9	88.6	91.2	91.2	106	106	82.4	71.7	60.1	81.1
min temp	48.7	58.8	59.2	66.4	72.5	81.5	48.7	87.5	48.7	73.3	58.3	50.2	62.8
ETo	1.08	1.87	3.73	5.45	7.42	8.05	8.57	7.5	5.61	3.84	1.89	1.06	56.1

Discuss the impact of climate, and any microclimates, on water management
Mild damp winters and long hot summers. While refuge objectives result in the majority of wetlands being flooded during the fall and winter (to mimic historic hydrologic patterns) those acres that remain flooded during spring and summer result in the greatest amount of water used per habitat acre.

4. Water quality monitoring

The refuge conducts bi-monthly water quality monitoring at 22 locations which include inlets, outlets, and wetland units. Water quality monitoring conducted at these locations tests for specific conductivity, temperature, total dissolved solids, salinity, dissolved oxygen, and pH. When they are operational grab samples are also taken at each of the 5 well locations. The Westside San Joaquin Watershed Coalition conducts water quality monitoring at 26 locations (3 inlets and 23 discharge points) that encompasses the San Luis National Wildlife Refuge and a large contiguous area. Please see the attached Westside San Joaquin River Watershed Coalition Semi-Annual Monitoring Report dated June 15, 2010 (attached) or visit the Coalition website at http://www.sldmwa.org/sjv_drainage_auth_.htm

Merced Unit

If the refuge has a water quality monitoring program complete this table

Analyses performed	*Frequency range*	*Concentration range*	*Average*
Dissolved oxygen			
Conductivity			
Molybdenum			
Phosphorus			
PH			
TDS			
Boron			
Sodium			

Arsenic			
Selenium			

Arena Plains Unit

If the refuge has a water quality monitoring program complete this table

Analyses performed	*Frequency range*	*Concentration range*	*Average*
Dissolved oxygen			
Conductivity			
Molybdenum			
Phosphorus			
PH			
TDS			
Boron			
Sodium			
Arsenic			
Selenium			

Snobird Unit

If the refuge has a water quality monitoring program complete this table

Analyses performed	*Frequency range*	*Concentration range*	*Average*
Dissolved oxygen			
Conductivity			
Molybdenum			
Phosphorus			
PH			
TDS			
Boron			
Sodium			
Arsenic			
Selenium			

Discuss the impact of water quality on water management

Comprehensive water quality information is lacking, however, datasets are being established which will soon be adequate to assist with the development and enhancement of existing refuge habitat management plans. This information is now being collected across the full range of refuge water facilities and wetland types and preliminary data summary and analysis has been initiated.

Section F Transfers, Exchanges and Trades

Provide information on any transfers, exchanges and/or trades into or out of the refuge

From whom	To whom	Report year (AF)	Use

NONE			
	TOTAL		

Section G Water Inventory

See Tables

Section H Critical Best Management Practices

1. Management Programs

    a. Education

Program	Estimated cost (in 1000s)		
	2011	2012	2013
Write Refuge Brochure	10K		
Public Events	5K	15K	15K
Student Tours	2K	2K	2K
Educational Materials		5K	
Staff Meetings/Informal Sessions	2K	2K	2K
Water Management Courses	2K	2K	2K

1. Complete a general San Luis National Wildlife Refuge Complex brochure, which includes San Luis NWR, Merced NWR and San Joaquin River NWR, which includes a section on water management and water supplies.

2. Complex staff will participate in large public events with a focus on natural resources such as the California State Fair, Merced County Fair, Stanislaus County Fair, and Water Education Foundation tours including messages on water management and water supplies.

3. Complex staff will continue to provide student tours on refuge units and include messages on water management and water supplies.

4. Produce education materials for the public which include a water management theme for natural resources at the Complex.

5. On an annual basis have Assistant Refuge Managers, Wildlife Biologists, Irrigators and other staff review current and potential best management practices for water management at the San Luis National Wildlife Refuge .

6. Periodically, send Complex staff to water management training courses.

    b. Water quality monitoring

Type of Water	Estimated cost (in thousands)		
	2011	2012	2013
Surface	$10	$10	$10
Upslope drain			
Groundwater	$2	$2	$15
Outflow	$5	$5	$5

Comprehensive water quality information is lacking, however, datasets are being established which will soon be adequate to assist with the development and enhancement of existing refuge habitat management plans. This information is now being collected across the full range of refuge water facilities and wetland types and preliminary data summary and analysis has been initiated.

c. Cooperative Efforts

Complex staff work closely with the local water districts coordinating water deliveries – timing, volume and rates. The staff also works with adjacent landowners, technical assistance as part of the Easement Program and coordinating discharges to make the most beneficial use of runoff from refuge units.

d. Pump evaluations

Total number of groundwater pumps on refuge – 27

Total number of surface water (low-lift) pumps on refuge – 9

Groundwater Pumps	Estimated cost (in thousands)		
	2011	2012	2013
# of groundwater pumps tested	2	4	4
# of pumps to be fixed or replaced	6	4	4
# of low-lift pumps to be tested	0	0	3
# of pumps to be fixed or replaced	2	2	LP9-10K

e. Policy Evaluation.

The Complex staff reviews policy and how it can achieve optimal water management on the refuge units on an annual basis. A common comment is the need for the ability to change USBR pre-determined/scheduled monthly quantities so that the refuge can use the available supply in response to unpredictable weather conditions and changing habitat needs.

Water management coordinator

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Phone 209 826-3508

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Section I Exemptible Best Management Practices

1. Improve management unit configuration

Unit name	*Current acres*	*Reason for change*	*Proposed acres*	*Estimated cost (in $1,000s)*		
				2011	*2012*	*2013*
Cinnamon Slough	59	Deepen and widen channels for improved wetland management	59	$100		
Teal Marsh A	21	Enlarge wetland basin and improve low flow channel for improved wetland management	50	17		

2. Improve internal distribution system

a. New control structures within distribution system

Proposed location	*Type of structure*	*Reason for new structure*	*Estimated cost (in $1,000s)*		
			2011	*2012*	*2013*
Duck Slough Canal	Replace 1 WCS	Existing structures leak		$20	
Merced As Needed	Replace 5 WCS	Existing structures leak	$5		$5
Snobird As Needed	Replace 2 WCS	Existing structures leak	$5		
Arena Plains As Needed	Replace 2 WCS	Existing structures leak		$5	

b. Line/pipe sections of distribution system:

Proposed reach/sect.	*Reason for new structure*	*Estimated cost (in $1,000s)*		
		2011	*2012*	*2013*
Well P6 pipeline section	Repair leak from cracked valve riser	$5		

c. Independent water control for each unit

Proposed control point	*Reason for new control point*	*Estimated cost (in $1,000s)*		
		2011	*2012*	*2013*
N &S Cackler	More efficient drainage			$4
Deadman Marsh AE	More efficient drainage			
West Farm 3	More efficient drainage	$8		

d. New internal distribution sections (pipe, canal) to provide water to existing and new habitat units

Proposed new section	*Units served*	*Reason for new section*	*Estimated cost (in $1,000s)*		
			2011	*2012*	*2013*
2,500 ft.	1	Convey water to S. Lone Tree Slough			$75
2,000 ft.	2	Convey water to middle Snobird wetlands		$25	

3. Develop a Water Use Schedule (See Appendix I)

Plan Element	*Completiond Date*	*Estimated cost (in $1,000s)*		
		2011	*2012*	*2013*
Floodup dates by unit	January	$2	$2	$2
Drawdown dates by unit	August	$2	$2	$2
Irrigation dates by unit	January	$2	$2	$2

Explore ability and potential water management value in automating water distribution system on refuge units with the BOR in FY13.

4. Measurement

a. Plan to measure outflow

Identify locations, prioritize, determine best measurement method/cost, submit funding proposal

	Estimated cost (in $1,000s)		
	2011	*2012*	*2013*
Identify locations	$20	$20	$20
Estimate outflow quantity/rank	$20	$20	$20
Develop plan	$20	$20	$20
Estimate construction start date	$20	$20	$20
Estimate construction completion date	$20	$20	$20

~~*5. Incentive pricing (GWD only)*~~

6. Construct and operate operational loss recovery systems

Proposed location	*Reason for improvement*	*Estimated cost (in $1,000s)*		
		2011	*2012*	*2013*

Explore ability and potential water management value in operating loss recovery systems with the BOR in FY13.

7. *Optimize conjunctive use of surface and groundwater*

Proposed production/ injection well	*Anticipated yield*	*Estimated cost (in $1,000s)*		
		2011	*2012*	*2013*

Explore a conjunctive use program if appropriate at the refuge. Managing the two water sources in a coordinated way so as to meet current and future demands and achieve increased water supply. This may involve developing programs with neighboring groundwater users. All refuge units in the local area, including the Merced NWR, are currently being evaluated in a comprehensive groundwater study, conducted by CH2MHiII, to see if there are further conjunctive use opportunities for state, federal, and private wetland areas. Explore the ability and potential water management value of this BMP with the BOR in FY15.

8. *Facilitate use of available recycled urban wastewater that otherwise would not be used beneficially, meets all health and safety criteria, and does not cause harm to wildlife management goals.*

Explore the potential for using recycled urban wastewater from the relicensing of the Atwater Waste Water Treatment Plant to meet wildlife management goals at the Arena Plains and Snobird units of the refuge with the BOR in FY12.

9. *Mapping*

GIS maps	*Estimated cost (in $1,000s)*		
	2011	*2012*	*2013*
Aerial Photographs		$5	
Develop Vegetation GIS layer	$10		
Develop Water Infrastructure GIS layer		$10	

If this BMP will not be implemented within two years of submitting this plan, describe the projected program, timeline and other relevant information.

10. *CAL-Fed Quantifiable Objectives*

Describe any past, present, or future plans that address the goals identified for this refuge

CalFed quantifiable objectives: The CalFed Bay-Delta Program is a cooperative effort among state and federal agencies and the public to ensure a healthy ecosystem, reliable water supplies, good quality water, and stable levees. Quantifiable Objectives represent an approximation of the practical and cost-effective

contribution irrigated agriculture or refuges can potentially make towards achieving CalFed's Quantified Target Benefits. These benefits include reducing salinity of return water, reducing nonproductive evapotranspiration, conjunctive use, reducing selenium and boron concentrations, and increasing additional river flows. The following CAL-FED quantifiable objectives have been identified for the Merced NWR:

- Describe actions that provide additional flow to San Joaquin River (TB 148),
- Describe actions that reduce salinity at Vernalis. (TB 154), and
- Describe actions that reduce nonproductive ET (TB 157).

To meet these objectives the following management practices will be employed and examined for use to both improve the water management efficiency and water quality at the refuge. These include policies, programs, practices, or uses of devices that allow refuge managers to more efficiently manage both their limited water amounts for migratory birds and other trust species as well as improving water quality. Some BMPs are considered the basic elements of good refuge habitat management. Restraints or cost of course make some BMPs difficult if not impossible to attain.

1. Delivery timing: Improve delivery timing to avoid water "stacking" or other inefficient water storage procedures. Refuge Progress: Staff works to achieve this goal in most instances, but there are times of the year when water stacking is an unavoidable measure taken to maintain adequate habitat during the late December/early January period.

2. Control of individual management units: Provide independent water control for each wetland unit. This action involves the improvement of control structures to improve habitat, water distribution, and assist with other refuge objectives. Specifically, may involve the addition of water control structures or the construction of shallow swale drains through ponds.

3. New and old control structures: Determining whether modifications to canals, pipelines, or gates would improve habitat, water distribution, and assist with other refuge objectives. New structures can increase water efficiency at refuge units and replacement of worn and leaky water control structures maintains and increases water efficiency. Roughly ten percent of the refuge water control structures, mostly risers, are usually replaced every year, resulting in a complete turnaround every 10 years.

4. Lining or piping sections of the distribution system: This action may increase distribution system flexibility and capacity; decrease maintenance; and reduce evaporation losses and seepage from earthen ditches and canals. Miles and miles of pipeline at this refuge has replaced unlined canals to improve water efficiency.

5. New internal distribution sections (such as a pipe or canal) to provide water to existing and new habitat units: For refuge units that cannot receive the quantity of water necessary at the correct time. May involve a new or improved delivery system sections to create better habitat, water distribution, and assist with other refuge objectives.

6. Interagency coordination: Coordinate water use and habitat and species maintenance goals with other refuges with the region. These cooperative efforts may be with federal or state agencies, other refuges, agricultural and urban contractors, public interest groups, and neighboring landowners. Programs include water supply trades based on water year precipitation, pooling of water supply or training programs.

7. Contour dikes: Install contour dikes to compensate for variable depth, where such practice is cost-effective and compatible with management objectives. This BMP is of limited value to refuges because it is not a cost-effective practice for FWS to implement or to meet its natural resource objectives. Existing variable depths in refuge wetlands, in most cases, are the desired situation, helping staff to manage the most diverse habitat for a diverse list of migratory birds.

8. Monitoring: Water management plans are updated annually by Complex staff and include the effectiveness of water use so that decisions can be modified in the future to improve water efficiency.

9. Leveling units: Level moist soil units, where appropriate, to increase production of high carbohydrate forage per unit of water applied. Practice may be limited by biodiversity and endangered species concerns and management objectives. Refuge wetland units usually have varied depths to meet several different refuge management objectives.

10. Pond bottom contours: Increase the unevenness of bottom contours to improve wetland productivity. Most refuge wetland units have varying depths but the Complex will examine this option for several wetland units.

11. Internal conveyance: Improve the efficiency of delivery by reducing evaporation via vegetation control. Reduce seepage from delivery ditches where appropriate (i.e., where not required for riparian vegetation management).

12. Unproductive areas: Manage unproductive units, or those that consistently use more water than others, as uplands to conserve water. Annually review water holding capacity of wetland units.

13. Conjunctive use: Implement a conjunctive use program if appropriate. Managing the two sources in a coordinated way so as to meet current and future demands and achieve increased water supply. This may involve developing programs with neighboring groundwater users. All refuge units in the local area are currently being evaluated in a comprehensive groundwater study, conducted by CH2M-HiII, to see if there are further conjunctive use opportunities for state, federal, and private wetland areas.

14. Pump efficiency evaluations: Achieve maximum efficiency at pumps and control points. A program to evaluate and improve the efficiencies of such pumps may result in energy savings, peak load reductions, or reveal capacity limitations due to inefficient facilities. Pump replacement may allow the reduction of operational costs and improve operational efficiency; making currently unused water supplies cost-effective. Deep will pumps are periodically checked to achieve maximum efficiency. Electrical energy rates are periodically reviewed to assure cost effectiveness of pump operations.

    - *In 2010, the American Recovery and Reinvestment Act of 2009 funded the replacement of motor heads and pumps in addition to other efficiency improvements to 10 wells on the Merced NWR totaling over $228,000.*
    - *In 2010, the FWS Deferred Maintenance program replaced a 50 HP deep well with a more energy efficient model.*

15. Water measurement: Achieve a better knowledge of volumes of water delivered to the refuge boundary and moved within the refuge to improve water management planning and management.

16. Water Quality Monitoring: Applies to refuges that rely on groundwater, upslope drainwater, or poor quality surface water (potential constituent problems include salts, boron, arsenic, selenium, or

pesticides). The refuge may be in a drainage problem area or where outflow spill water quality is a concern, where these constituents may adversely affect habitat quality.

17. Water recirculation and cycling: Explore water re-use programs within the wetland units of the refuge. Several wetland units currently make use of water from upslope wetland units.

18. Education: Either sponsoring or conducting educational seminars/workshops for refuge staff or public. Examples include information on weather, habitat characteristics and water delivery scheduling, and water distribution planning. Preferably involves technical experts, if available, and may rely on local, state, or federal agencies such as the Agricultural Research Service and U.C. Cooperative Extension. Workshops can be used to communicate the importance of specific conservation plans, describe conservation procedures that refuge staff can utilize, or provide a forum for refuge staff to exchange ideas and experiences. In addition, two full-time refuge staff spends the majority of their time consulting with private wetland owners regarding optimizing habitat and the best management of the limited resources; as well as forming funding partnerships to implement these actions. Staff participates in the yearly landowner meetings held at the Grassland Water District. Occasional agency/conservation group "wetland workshops" are held every few years to share ideas, describe successful programs, problem-solving, etc.

19. Policy evaluation: Changes to the rules and regulations of the refuge's water suppliers and/or conveying entities that would allow for more efficient water use and operations. Water Projects (CVP, SWP, etc.) provide water based on policies that sometimes make refuge management more difficult. For instance, policies that require scheduling water months in advance or that restrict carry-over of unused water, can encourage unnecessary water use. Other examples include restrictions on timing and duration of deliveries or limited flexibility in scheduling changes.

20. Water shortage contingency planning: These plans address ways that maintain habitat during reductions in normal supply of up to 50 percent.

21. Improving management unit configuration: Evaluating whether modifications to units would improve habitat, water distribution, and assist in other refuge objectives.

22. Automate water distribution system: May increase flexibility in water deliveries and increase the refuge's control over its water supplies, thus providing the opportunity to improve the efficiency of water use. This has not been used extensively in wetland management due to the high expense involved in instituting the equipment. Also, the most effective marsh management requires someone to be on the site evaluating that particular day's habitat condition and the necessary amount of water application.

23. Measurement: A plan to measure outflow to determine the amount of water leaving the refuge using methods or devices that are operated and maintained to a reasonable degree of accuracy, under most conditions, to +/-20.

24. Construct and operate operational loss recovery systems: May involve the design and construction of interceptor systems designed to capture and transport operational spills throughout a refuge internal distribution system.

25. Mapping: Developing and maintaining detailed maps which delineate the refuge's distribution system, water control structures, canals, pipelines, outflow locations, and measurement device locations.

26. Annual Water Quality Meetings and BMP Updates: Initiate annual water quality meetings among the federal and state agencies to discuss monitoring efforts, studies, management actions, and to update this plan.

27. Conduct Studies of Water Needs of Different Wetland Types: Investigate the actual water needed for managing various wetland types as well as the drainwater produced by each.

28. Conduct Studies of the Quality of Water Used in Wetland Management: Document the water quality of incoming and outgoing water on wetland units to ascertain if wetland management changes water quality.

29. Conduct Water Quality Studies of Drainwater from Different Wetland Sub-Units of the Refuge. Ascertain if the water quality of drainwater varies and to what extent through the Refuge to identify if specific problem areas exist.

30. Work with Water Districts to Improve Water Quality: Partner with water districts to identify water quality issues of delivered water and develop corrective actions where feasible.

31. Cap Wells with Water Quality Issues: Close wells in the refuge where water quality issues have been identified.

- *In 2010, the Merced NWR removed one energy inefficient well from service.*

If reducing nonproductive ET involves removing invasive plants, complete the following:

Invasive unwanted species name	Estimated acres			*Estimated cost (in $1,000s)*		
	2011	*2012*	*2013*	*2011*	*2012*	*2013*
Perennial pepperweed	250	250	100	$3	$2	$1
Five-hooked bassia	300	300		$5	$5	
Water Hyacinth	50	50		$2	$2	

Section J BMP Exemption Requests

For each BMP for which the refuge is seeking an exemption, provide a detailed narrative and complete the summary table

Summary of BMP exemptions

BMP	*Constraint*[1]	*Outstanding Need*[2]
NA	NA	NA
NA	NA	NA

1. *Constraint – list existing constraint. Use additional rows for multiple BMPs or constraints. Identify Legal (L), Environmental (EN), or Economic (EC) issues using code. If the BMP is not seen as beneficial, provide detailed information*
2. *Outstanding need – identify assistance required to implement the BMP. State specific funding or other assistance required*

Provide a detailed exemption request below for each BMP listed in the summary table

Non-Applicability (N/A) of Exemptible BMPs

To establish that a BMP is not applicable to the Refuge, the Plan should explain the reasons why the BMP does not apply to the Refuge. This justification must be consistent with Section A of the Criteria titled, "Background." Examples of non-applicability for each exemptible BMP are listed below. This list is not all-inclusive.

APPENDIX I

Draw Down Schedule (Merced Unit)

Proposed Drawdown Date	WETLAND UNIT	Drawdown Rate	Actual Drawdown Date	FIRST IRRIGATION START DATE	SECOND IRRIGATION START DATE	MANAGEMENT GOAL OR PRESCRIPTION
Mar 1-10	East Marsh F	Fast				Post Rehab-swamp timothy
Mar 1-10	North Cackler	Fast				Post Rehab-swamp timothy
Mar 11-20	Lonetree South	Slow				Swamp Timothy Unit
Mar 11-20	East Marsh D	Fast				Swamp Timothy Unit
Mar 21-30	West Marsh C	Slow				Swamp Timothy Unit
Mar 21-30	Teal Marsh B	Slow				Swamp Timothy Unit
Mar 21-30	Mariposa B	Fast				Rehab - watergrass
Apr 1-10	Lonetree North	Fast				Swamp Timothy Unit
Apr 1-10	East Marsh C	Fast				Swamp Timothy Unit
Apr 1-10	Pintail Marsh A	Slow				Swamp Timothy Unit
Apr 1-10	East Marsh E	Slow				Mixed Marsh
Apr 1-10	Snow Goose Lake (bench)	Slow				Swamp Timothy Unit
Apr 1-10	Deadman Creek B	Slow				Swamp Timothy
Apr 1-10	Honker Lake	Slow				Swamp Timothy Unit
Ap 11-20	East Marsh B	Slow				Mixed Marsh
Apr 11-20	Crane Field A	Slow				Mixed Marsh
Apr 11-20	Dunlin Flat	Slow				Swamp Timothy Unit
Apr 11-20	Deadman Creek A	Slow				Mixed Marsh
Apr 11-20	West Marsh E	Slow				Mixed Marsh
Apr 11-20	Pintail Marsh B	Slow				Swamp Timothy
Apr 11-20	West Dowitcher	slow				Swamp Timothy
Apr 21-30	Crane Field B	Slow				Rehab
Apr 21-30	Mariposa A	Slow				Swamp

			Timothy/Watergrass
Apr 21-30	West Marsh B	Fast	Mixed Marsh
Apr 21-30	Horseshoe	Fast	
Apr 21-30	Deadman Creek C	Fast	Swamp Timothy
Apr 21-30	East Marsh G	Fast	Mixed Marsh
Apr 21-30	Teal Marsh A	Slow	rehab (part of NAWCA)
May 1-10	West Marsh F	Slow	Rehab
May 1-10	Mariposa C	Slow	Watergrass-mixed marsh
May1-10	East Dowitcher	Slow	Watergrass
May 1-10	West Marsh D	slow	watergrass
May 1-10	Pintail Marsh C	Slow	Rehab
May 11-20	West Marsh A	Slow	Rehab
May 11-20	Mallard Pond A & B	Slow	Rehab
June 10-21	Section 35 Swales	let evap	Natural upland swales
Aug 15-25	Mariposa Borrow Pit	let evap	dd to avoid killing trees
Oct 1-10	Cinnamon Slough	Fast	Semi Permanaent Wetlands
Nov 21-30	South Cackler	let evap	Modified semi-permanent
Permanent	Bittern Marsh		Currently dry for rehab
Permanent	Snow Goose (lower)		Permanent Wetlands
Permanent	Luna Lake		Permanent Wetlands
Permanent	Mariposa Creek Channel		Permanent Wetlands
Permanent	Glory Hole		Permanent Wetlands

Flood Up Schedule (Merced Unit)

WETLAND UNIT	ACRES	PROPOSED FLOOD DATE	CUMULATIVE ACRES	% OF TOTAL FLOODED
Glory Hole North	7	Permanent		
Glory Hole South	14	Permanent		
Luna Lake	5	Permanent		
Snow Goose	20	Permanent		
Mariposa Channel Middle		Permanent		
Lonetree Bypass Channel		Permanent	46	3
Honker Lake	40	Aug. 17		
Pintail Marsh C	30	Aug. 25		
Lonetree Bypass channel Ponds		Sept. 1	116	7
West Marsh F	15	Sept. 5		
West Dowitcher	24	Sept. 10		
Teal Marsh B	25	Sept. 10		

Crane Field A	60	Sept. 10		
Horseshoe Pond	24	Sept. 15	240	15
West Marsh E	29	Sept. 15		
Mariposa A	94	Sept. 15		
Pintail Marsh B	50	Sept. 20		
West Marsh D	34	Sept. 20		
Deadman B	24	Sept. 20		
Mallard Pond A	26	Sept. 25		
Mallard Pond B	26	Sept. 25		
Mariposa Borrow Pits	39	Sept. 25		
West Marsh B	78	Sept. 25		
Mariposa B	54	Sept. 30		
Mariposa C	12	Sept. 30		
Mariposa Channel North		Sept. 30	730	47
West Marsh C	28	Oct. 5		
Crane Field B	52	Oct. 5		
East Marsh E	51	Oct. 5		
West Marsh A	36	Oct. 10		
Deadman A	30	Oct. 10		
East Marsh C	64	Oct. 10		
Dunlin Flat	40	Oct. 15		
East Marsh B	30	Oct. 15		
East Dowitcher	29	Oct. 15		
Lonetree North	82	Oct.15		
Teal Marsh A	21	Oct. 20		
Deadman C	26	Oct. 20		
Lonetree South	69	Oct. 20	991	63
Pintail Marsh A	39	Oct. 25		
East Marsh G	21	Oct. 25		
North Cackler	20	Oct. 25		
East Marsh D	34	Oct. 25	1402	89
East Marsh F	37	Dec.1		
Section 35 Slough	40	Dec. 1		
Bittern Marsh	5	Dec.1		
Cinnamon Slough	59	Feb. 1		
South Cackler	26	Mar. 15	1569	100
Total	1569			

Flood Up Schedule (Arena Plains Unit)

WETLAND UNIT	ACRES	PROPOSED FLOOD DATE	CUMULATIVE ACRES	% OF TOTAL FLOODED
Tricolored Slough	27	Permanent		
Sunrise Lake	93	Aug. 25		
Crane Lake	150	Sept. 10		
Cackler Lake	85	Nov. 1		
Pelican Lake	70	Dec. 1		
South Lake	37	(natural flood-up)		
Total	462			

Drought Contingency Plan for the San Luis National Wildlife Refuge and Merced National Wildlife Refuge

In the event of drought the management of water dependent habitats and biotic communities will be adjusted according to the severity of the water reduction as well as the timing of the shortage. Drought notifications and water shortages can occur at any time during the year and span a number of years. Because of the variability of drought notifications and severity we do not have a specific prescription for the San Luis NWR and Merced NWR instead based on the time of year notification and predicted duration we will examine several water management parameters to gauge the most efficient way to employ a reduced water impact while minimizing the impacts to wildlife and other natural resources. Wetland and upland management actions which will be considered in the event of drought are outlined in this plan.

Wetland Management

Wetlands on the San Luis and Merced National Wildlife Refuges are managed to provide optimal habitat conditions for wintering waterfowl, waterbirds, and a large suite of other biota. Managed wetland habitats include seasonal wetlands, reverse cycle wetlands, semi-permanent wetlands, and permanent wetlands.

If the drought is scheduled far enough in advance (for example before the annual flood-up of seasonal wetlands which begins in late August), a decision may be made to reduce the acreage of managed wetlands impacted by delaying or deferring flood-up of certain units or reducing the number of managed units receiving water. If a mid-winter drought occurs, water may be stockpiled on managed wetland units by filling the units to capacity. This strategy may be enhanced by reducing drainage off the units to the minimum necessary to assure adequate water quality. Another strategy which may be employed is an early drawdown of wetlands to reduce the total amount of water needed to maintain the extant wetland acreage.

When delivered water supplies run short, water rights to surface water resources may be exploited via lift pumps. Deep wells may also be used to pump groundwater into canals or directly into managed wetlands to augment or replace inadequate delivered water supplies.

Upland Management

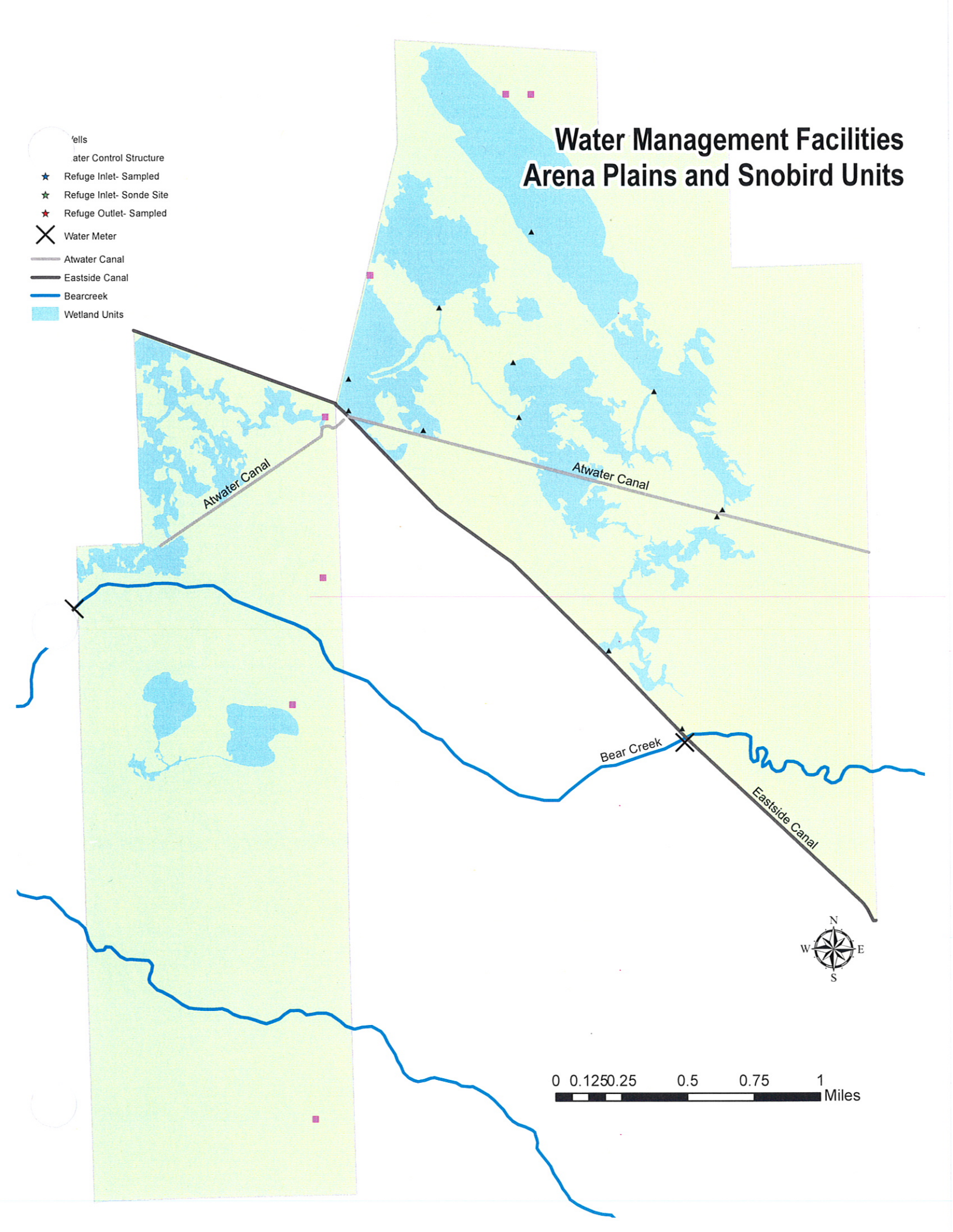
Uplands on the San Luis and Merced National Wildlife Refuges are managed to provide optimal habitat conditions for a suite of short grass-dependent species such as the long billed curlew, arctic nesting geese, and the San Joaquin kit fox as well as for grassland nesting birds. Categories of uplands include restored upland, irrigated pasture, cereal grain plantings and special ecological communities (Iodine Bush and vernal pool).

Restored upland habitats which include restored wetland meadow, grassland, and woodland habitat, are typically irrigated two to three times between February and August. Irrigated pasture is typically irrigated bi-monthly between April and November. Drought will be addressed in these habitats by lengthening the period between irrigations or

reducing acreage being irrigated. Water shortage to planted cereal grains will be addressed by planting winter wheat later in the season and by utilizing dry farming techniques. Reductions will be made in the total acreage of corn planted based on projected water availability.

Non – irrigated habitats including Iodine Bush and vernal pool communities will not be affected by reduced water allocations. These communities are extremely resilient in the face of drought.

Water Management Facilities
Merced Unit


Water Management Facilities
Arena Plains and Snobird Units
ells
ater Control Structure
Refuge Inlet- Sampled
Refuge Inlet- Sonde Site
Refuge Outlet- Sampled
Water Meter
Atwater Canal
Eastside Canal
Bearcreek
Wetland Units
Atwater Canal
Atwater Canal
Bear Creek
Eastside Canal
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Miles

Merced Unit Merced NWR
Water Management Facilities

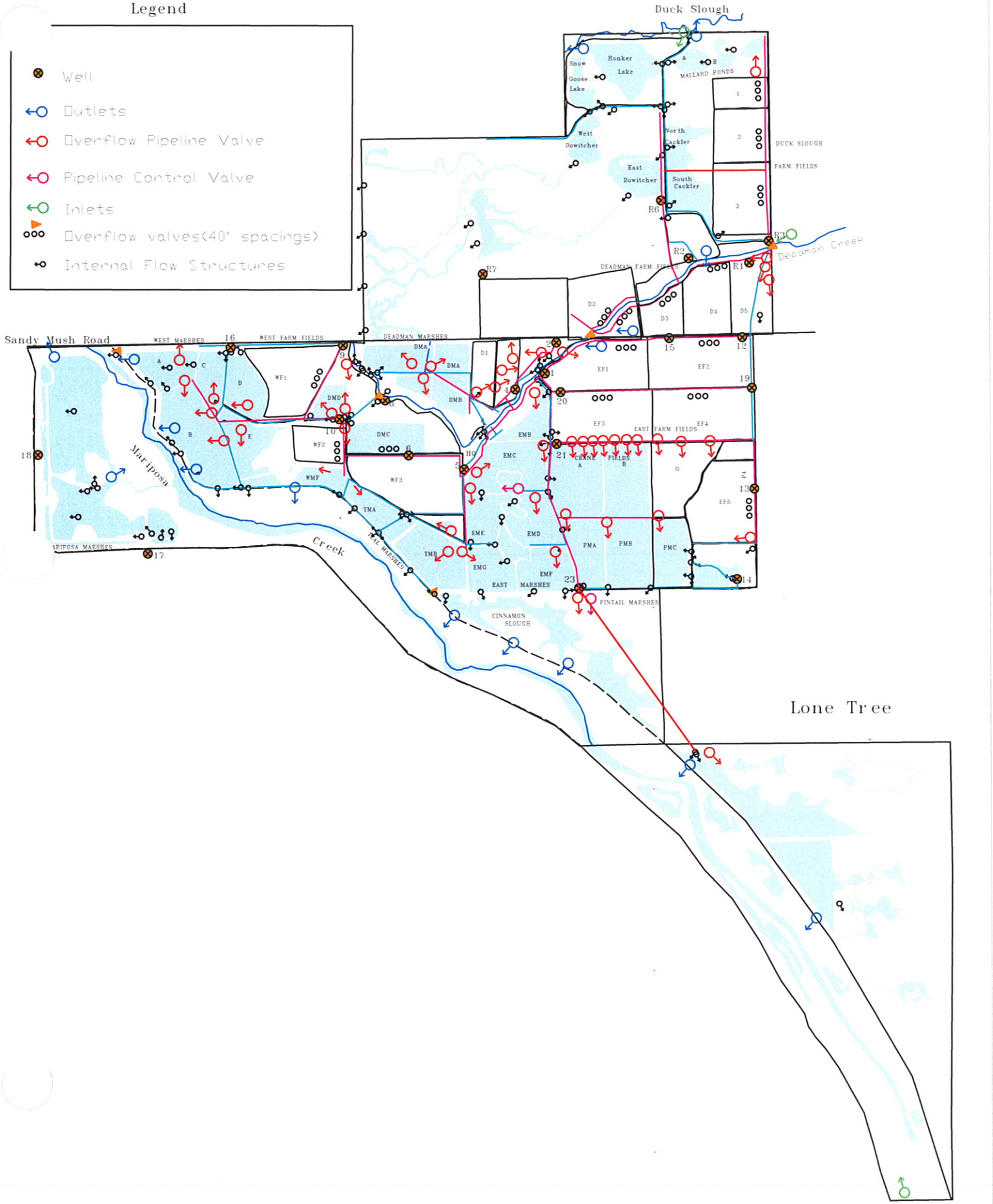

Table 1

Water Supply

2010	Federal Wtr Level 2 (acre-feet)	Federal Wtr Level 4 (acre-feet)	Local Water Supply (acre-feet)	Refuge Groundwtr (acre-feet)	Up Slope Drain Wtr (acre-feet)	other (define) (acre-feet)	Total (acre-feet)
Method							
Jan-2010	0	0	0	2006	0	0	2,006
February	0	0	0	1706	0	0	1,706
Mar-2009	214	0	0	1600	0	0	1,814
April	1239	0	0	42	0	0	1,281
May	1220	0	0	71	0	0	1,291
June	1598	0	0	37	0	0	1,635
July	1461	0	0	43	0	0	1,504
August	1321	0	0	0	0	0	1,321
September	1908	0	0	0	0	0	1,908
October	2112	0	0	89	0	0	2,201
November	105	0	0	1845	0	0	1,950
December	0	0	0	2009	0	0	2,009
TOTAL	11,178	0	0	9,448	0	0	20,626

*March 1, 2009 - February 28, 2010

Measurement Method	Definiti
M1	Measured sum
M2	Measured sum
M3	Measured sum
C1	Calculated (mc
C2	Calculated usi
C3	Calculated usi
E1	Estimated usin
E2	Estimated usin
E3	Estimated usin
O1	Other (attach a

Table 2

Internal Distribution System

Year	2010								
Canal, lateral	Length (feet)	Width (feet)	Surface Area (square feet)	Precip. (acre-feet)	Evaporation (acre-feet)	Seepage (acre-feet)	Operational losses (acre-feet)	Measure method see Cell K5	Total (acre-feet)
All unlined ditch	13,200	10	132,000	1.44	13.01	19	206	E3*	(237)
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
			0	0.00	0.00				0
TOTAL	13,200		132,000	1	13	19	206		(237)
			3	acres					

Table 3

Managed Lands Water Needs

Year 2010						Shallow		Cultural	
Habitat Type	Area habitat acres	Habitat Water Needs (AF/ac)	AF/ac water (AF/ac)	Delivered Water (Total AF)	Precip (AF/Ac)	Groundwtr (AF/Ac)	Evap (AF/Ac)	Practices (AF/Ac)	Seepage (AF/Ac)
Seasonal wetlands: timothy	0	5.00	0.00	0	0.42	0.00	1.75	0.00	
Seasonal wetlands: smartweed	1,554	6.00	8.00	12,432	0.45	0.00	2.94	0.00	3.46
Seasonal wetlands: watergrass	0	8.00	8.00	0	0.45	0.00	2.94	0.00	
Permanent wetlands	41	12.00	10.00	410	0.47	0.00	4.29	0.00	3.71
Semi-perm wetlands/brood pond	88	10.00	8.75	770	0.47	0.00	4.29	0.00	2.71
Riparian	48	12.00	0.00	0	0.45	0.00	2.94	0.00	
Irrigated pasture	391	3.00	2.00	782	3.50	0.00	3.69	0.00	0.00
Cropland (grains)	453	2.00	2.00	906	0.63	0.00	2.55	0.00	0.00
(define)				0	0.00	0.00	0.00	0.00	0.00
(define)				0	0.00	0.00	0.00	0.00	0.00
Total Habitat Acres	**2,575**	**5.18**	**5.94**	**15,300**					

Table 4

Refuge Water Inventory

Year	2010	Reference		
Total Water Supply		**Table 1**		20,626
Precipitation		**Table 2**	**plus**	1
Evaporation		**Table 2**	**minus**	13
Seepage		**Table 2**	**minus**	19
Operational Losses		**Table 2**	**minus**	206
		Deliveries to Managed Lands		20,389
Managed Land needs		**Table 3**	**minus**	13,351
Difference		**(calculated)**		7,038
		Balance (outflow?) (Table 3)		4,115
		Water Inventory Balance		11,153

Table 5

Annual Water Quantities Delivered Under Each Right or Contract

Year	Federal Wtr Level 2 (acre-feet)	Federal Wtr Level 4 (acre-feet)	Local Water Supply (acre-feet)	Refuge Groundwtr (acre-feet)	Up Slope Drain Wtr (acre-feet)	other (define) (acre-feet)	Total (acre-feet)
2001	11,368	0	0	0	0	0	**11,368**
2002	11,026	0	0	3,348	0	0	**14,374**
2003	9,973	0	0	4,285	0	0	**14,258**
2004	10,168	0	0	5,558	0	0	**15,726**
2005	8,833	0	0	2,199	0	0	**11,032**
2006	6,890	0	0	8,260	0	0	**15,150**
2007	10,600	0	0	9,090	0	0	**19,690**
2008	9686.00	0	0	12,211	0	0	**21,897**
2009	11,658	0	0	8,876	0	0	**20,534**
2010	11,178	0	0	9,448	0	0	**20,626**
Total	**90,012**	**0**	**0**	**63,275**	**0**	**0**	**164,655**
Average	**10,001**	**0**	**0**	**6,328**	**0**	**0**	**16,466**

APPENDIX I

Draw Down Schedule (Merced Unit)

Proposed Drawdown Date	WETLAND UNIT	Drawdown Rate	Actual Drawdown Date	FIRST IRRIGATION START DATE	SECOND IRRIGATION START DATE	MANAGEMENT GOAL OR PRESCRIPTION
Mar 1-10	East Marsh F	Fast				Post Rehab-swamp timothy
Mar 1-10	North Cackler	Fast				Post Rehab-swamp timothy
Mar 11-20	Lonetree South	Slow				Swamp Timothy Unit
Mar 11-20	East Marsh D	Fast				Swamp Timothy Unit
Mar 21-30	West Marsh C	Slow				Swamp Timothy Unit
Mar 21-30	Teal Marsh B	Slow				Swamp Timothy Unit
Mar 21-30	Mariposa B	Fast				Rehab - watergrass
Apr 1-10	Lonetree North	Fast				Swamp Timothy Unit
Apr 1-10	East Marsh C	Fast				Swamp Timothy Unit
Apr 1-10	Pintail Marsh A	Slow				Swamp Timothy Unit
Apr 1-10	East Marsh E	Slow				Mixed Marsh
Apr 1-10	Snow Goose Lake (bench)	Slow				Swamp Timothy Unit
Apr 1-10	Deadman Creek B	Slow				Swamp Timothy
Apr 1-10	Honker Lake	Slow				Swamp Timothy Unit
Ap 11-20	East Marsh B	Slow				Mixed Marsh
Apr 11-20	Crane Field A	Slow				Mixed Marsh
Apr 11-20	Dunlin Flat	Slow				Swamp Timothy Unit
Apr 11-20	Deadman Creek A	Slow				Mixed Marsh
Apr 11-20	West Marsh E	Slow				Mixed Marsh
Apr 11-20	Pintail Marsh B	Slow				Swamp Timothy
Apr 11-20	West Dowitcher	slow				Swamp Timothy
Apr 21-30	Crane Field B	Slow				Rehab
Apr 21-30	Mariposa A	Slow				Swamp Timothy/Watergrass
Apr 21-30	West Marsh B	Fast				Mixed Marsh
Apr 21-30	Horseshoe	Fast				
Apr 21-30	Deadman Creek C	Fast				Swamp Timothy
Apr 21-30	East Marsh G	Fast				Mixed Marsh
Apr 21-30	Teal Marsh A	Slow				rehab (part of NAWCA)
May 1-10	West Marsh F	Slow				Rehab
May 1-10	Mariposa C	Slow				Watergrass-mixed marsh
May1-10	East Dowitcher	Slow				Watergrass

May 1-10	West Marsh D	slow	watergrass
May 1-10	Pintail Marsh C	Slow	Rehab
May 11-20	West Marsh A	Slow	Rehab
May 11-20	Mallard Pond A & B	Slow	Rehab
June 10-21	Section 35 Swales	let evap	Natural upland swales
Aug 15-25	Mariposa Borrow Pit	let evap	dd to avoid killing trees
Oct 1-10	Cinnamon Slough	Fast	Semi Permanaent Wetlands
Nov 21-30	South Cackler	let evap	Modified semi-permanent
Permanent	Bittern Marsh		Currently dry for rehab
Permanent	Snow Goose (lower)		Permanent Wetlands
Permanent	Luna Lake		Permanent Wetlands
Permanent	Mariposa Creek Channel		Permanent Wetlands
Permanent	Glory Hole		Permanent Wetlands

Flood Up Schedule (Merced Unit)

WETLAND UNIT	ACRES	PROPOSED FLOOD DATE	CUMULATIVE ACRES	% OF TOTAL FLOODED
Glory Hole North	7	Permanent		
Glory Hole South	14	Permanent		
Luna Lake	5	Permanent		
Snow Goose	20	Permanent		
Mariposa Channel Middle		Permanent		
Lonetree Bypass Channel		Permanent	46	3
Honker Lake	40	Aug. 17		
Pintail Marsh C	30	Aug. 25		
Lonetree Bypass channel Ponds		Sept. 1	116	7
West Marsh F	15	Sept. 5		
West Dowitcher	24	Sept. 10		
Teal Marsh B	25	Sept. 10		
Crane Field A	60	Sept. 10		
Horseshoe Pond	24	Sept. 15	240	15
West Marsh E	29	Sept. 15		
Mariposa A	94	Sept. 15		
Pintail Marsh B	50	Sept. 20		
West Marsh D	34	Sept. 20		
Deadman B	24	Sept. 20		
Mallard Pond A	26	Sept. 25		
Mallard Pond B	26	Sept. 25		
Mariposa Borrow Pits	39	Sept. 25		

West Marsh B	78	Sept. 25		
Mariposa B	54	Sept. 30		
Mariposa C	12	Sept. 30		
Mariposa Channel North		Sept. 30	730	47
West Marsh C	28	Oct. 5		
Crane Field B	52	Oct. 5		
East Marsh E	51	Oct. 5		
West Marsh A	36	Oct. 10		
Deadman A	30	Oct. 10		
East Marsh C	64	Oct. 10		
Dunlin Flat	40	Oct. 15		
East Marsh B	30	Oct. 15		
East Dowitcher	29	Oct. 15		
Lonetree North	82	Oct.15		
Teal Marsh A	21	Oct. 20		
Deadman C	26	Oct. 20		
Lonetree South	69	Oct. 20	991	63
Pintail Marsh A	39	Oct. 25		
East Marsh G	21	Oct. 25		
North Cackler	20	Oct. 25		
East Marsh D	34	Oct. 25	1402	89
East Marsh F	37	Dec.1		
Section 35 Slough	40	Dec. 1		
Bittern Marsh	5	Dec.1		
Cinnamon Slough	59	Feb. 1		
South Cackler	26	Mar. 15	1569	100
Total	1569			

Flood Up Schedule (Arena Plains Unit)

WETLAND UNIT	ACRES	PROPOSED FLOOD DATE	CUMULATIVE ACRES	% OF TOTAL FLOODED
Tricolored Slough	27	Permanent		
Sunrise Lake	93	Aug. 25		
Crane Lake	150	Sept. 10		
Cackler Lake	85	Nov. 1		
Pelican Lake	70	Dec. 1		
South Lake	37	(natural flood-up)		
Total	462			